

MANAGEMENT APPROVAL

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ABSTRACT SUBMITTAL FORM

Unclassified Abstract *(250-300 words; do not include figures or tables)*

The Robotic Lunar Lander Development (RLLD) Project Office at NASA Marshall Space Flight Center (MSFC) has studied several lunar surface science mission concepts. These missions focus on spacecraft carrying multiple science instruments and power systems that will allow extended operations on the lunar surface. Initial trade studies of launch vehicle options for these mission concepts indicate that the spacecraft design will be significantly mass-constrained.

To minimize mass and facilitate efficient packaging, the notional propulsion system for these landers has a baseline of an ultra-high pressure (10,000 psig) helium pressurization system that has been used on Defense missiles. The qualified regulator is capable of short duration use; however, the hardware has not been previously tested at NASA spacecraft requirements with longer duration. Hence, technical risks exist in using this missile-based propulsion component for spacecraft applications.

A 10,000-psig helium pressure regulator test activity is being carried out as part of risk reduction testing for MSFC RLLD project. The goal of the test activity is to assess the feasibility of commercial off-the-shelf ultra-high pressure regulator by testing with a representative flight mission profile. Slam-start, gas blowdown, water expulsion, lock-up, and leak tests are also performed on the regulator to assess performance under various operating conditions.

The preliminary test results indicated that the regulator can regulate helium to a stable outlet pressure of 740 psig within the +/- 5% tolerance band and maintain a lock-up pressure less than +5% for all tests conducted. Numerous leak tests demonstrated leakage less than 10⁻³ standard cubic centimeters per second (SCCS) for internal seat leakage at lock-up and less than 10⁻⁵ SCCS for external leakage through the regulator ambient reference cavity.

The successful tests have shown the potential for 10,000 psig helium systems in NASA spacecraft and have reduced risk associated with hardware availability and hardware ability to meet RLL mission requirements.